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Impact of Different Insecticidal Modules on Pod Borer Complex in Pigeonpea

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ABSTRACT: Ravages by different pod borers during flowering and pod formation stage of pigeonpea are the major bottlenecks in attainment of desired productivity levels of pigeonpea along with sucking pests like jassids and cow bugs in severe case. The pod borer complex comprising, gram pod borer, *Helicoverpa armigera,* spotted pod borer, *Maruca vitrata* and pod fly, *Melanagromyza obtusa* cause a yield loss up to 60 per cent. Seven insecticidal modules along with an untreated control were evaluated in randomized block design (RBD) at Regional Agricultural Research Station, Lam, Guntur for three years i.e., from 2015-16 to 2017-18 on redgram var. ICPL 85063 (Lakshmi) under rain-fed conditions. The results revealed that insecticidal module consisting of chlorantraniliprole, followed by flubendiamide and dimethoate at 15 days interval starting from 50% flowering stage of the crop was found effective and recorded low pod damage due to *H. armigera*, *M. vitrata* and *M. obtusa* (2.5, 4.9 and 7.7 per cent pod damage, respectively) over control (12.6, 18.8 and 32.5%, respectively). Overall, the pod borer complex was lowest (15.2%) and recorded 76.2% reduction of pod damage due to pod borer complex over control (63.9%). Further, recorded highest yield (1974 kg/ha) and highest incremental cost benefit ratio (10.60) than rest of the treatments.

Keywords: Cost benefit ratio, Insecticides, Pigeonpea, Pod borers, pod borer complex.

INTRODUCTION

Pigeonpea (*Cajanus cajan* (L) Millsp.)) is a tropical grain legume mainly grown in India and ranks second in area and production and contributes about 90% in the world's pulse production. In India, during 2019-20, the crop was cultivated in an area of 4.23 million ha with 3.89 million tons and 919 kg ha^{-1} of productivity. In Andhra Pradesh, during 2018-19, it was cultivated in an area of 2.81 lakh ha with 1.58 lakh tons of production and 564 kg ha^{-1} of productivity (Anonymous, 2020). Though the area under redgram is increasing, the yields have remained stagnant (500-700 kg per ha) for the past 3-4 decades due to insect pest damage particularly, gram pod borer, *Helicoverpa armigera*, spotted pod borer, *Maruca vitrata* and pod fly, *Melanagromyza obtusa* are very important causing heavy yield loss (Sharma *et al.*, 2011). The yield loss due to *H. armigera*, *M. vitrata* and pod fly was up to 60, 84 and 80%, respectively (Vishakantaiah and Jagadeesh Babu, 1980; Subharani and Singh, 2009). The annual monitory loss due to *H. armigera*, *M. vitrata* and *M. obtusa* was estimated globally as US $ 400 million (ICRISAT, 2007), US $ 30 million (Saxena *et al.*, 2002) and US $ 256 million (ICRISAT, 1992), respectively. Considerable number of insecticides have been tested and few of them found effective against pod borers in pigeonpea (Yadav and Dahiya, 2004). However, indiscriminate use of insecticides has resulted in the development of resistance, resurgence and adversely affected the crop ecosystem and increased the total cost of production. In recent past more emphasis has been given on safer and eco-friendly management of pests. Though lot of research was done on individual pest and its management, limited efforts were made to manage the pod borer complex. Hence, the present studies were formulated and conducted at Regional Agricultural Research Station, Lam, Guntur.

MATERIALS AND METHODS

Seven insecticidal modules along with an untreated control were evaluated in randomized block design (RBD) at Regional Agricultural Research Station, Lam, Guntur from 2015-16 to 2017-18 on redgram var. ICPL 85063 (Lakshmi) under rain-fed conditions (Table 1). Considering, high incidence of pod borers during flowering and pod formation stage (Deshmukh *et al.*, 2003), each insecticide module consisting of three insecticidal sprays were given at 15 days interval starting from 50 per cent flowering stage of the crop. The larval population of *H. armigera* and *M. vitrata* was recorded at 5 and 10 days after each spray. The pods damaged due to different pod borers *viz.*, *H. armigera, M. vitrata* and *M. obtusa* were identified and separated out based on the characteristic appearance of holes and percent pod damage was calculated. Further, pod borer complex damage was calculated. The data on sucking pests like jassids was recorded on top 3 leaf lets and cow bugs was recorded on 3 branches per plant. The plot yield obtained was converted into yield per hectare and incremental cost benefit ratio (ICBR) was calculated. The data obtained was subjected to statistical analysis using AGRES package (Gomez and Gomez, 1984).

Table 1: Impact of different insecticidal modules against pod borers in pigeonpea.

Module No.	Treatment details	*H. armigera* larval population DBS	No. of *H. armigera* larvae/plant					*M. vitrata* larval population DBS	No. of *M. vitrata* larvae/plant during				
			2015	2016	2017	Overall efficacy	Reduction over control (%)		2015	2016	2017	Overall efficacy	Reduction over control (%)
M1	Acephate 75 SP – Acephate 75 SP – Chlorantraniliprole 18.5 SC	2.1	0.6 (1.3)	0.7 (1.3)	0.7 (1.3)	0.7 (1.3)	84.0	7.6	2.2 (1.8)	1.9 (1.8)	2.4 (1.9)	2.2 (1.8)	77.3
M2	Acetamiprid 20 SP – Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	2.2	2.1 (1.8)	1.9 (1.7)	2.3 (1.8)	2.1 (1.8)	52.3	7.9	5.0 (2.5)	6.4 (2.7)	3.9 (2.2)	5.1 (2.5)	47.4
M3	Dimethoate 30 EC – Dimethoate 30 EC – Chlorantraniliprole 18.5 SC	2.0	1.2 (1.5)	1.0 (1.4)	1.4 (1.6)	1.2 (1.5)	72.7	6.7	3.4 (2.1)	3.8 (2.2)	3.0 (2.0)	3.4 (2.1)	65.0
M4	Chlorantraniliprole 18.5 SC - Acephate 75 SP – Chlorantraniliprole 18.5 SC	2.0	0.4 (1.2)	0.3 (1.2)	0.4 (1.2)	0.4 (1.2)	90.9	8.2	1.5 (1.6)	1.5 (1.6)	1.6 (1.6)	1.5 (1.6)	84.5
M5	Chlorantraniliprole 18.5 SC- Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	1.6	0.9 (1.4)	0.5 (1.2)	1.3 (1.5)	0.9 (1.4)	79.6	7.9	2.6 (1.9)	2.2 (1.7)	3.0 (2.0)	2.6 (1.9)	73.2
M6	Chlorantraniliprole 18.5 SC- Indoxacarb 15.8 EC - Acetamiprid 20 SP	1.9	0.8 (1.3)	0.6 (1.3)	1.0 (1.4)	0.8 (1.3)	81.8	7.2	2.5 (1.9)	3.0 (2.0)	1.9 (1.7)	2.5 (1.9)	74.2
M7	Chlorantraniliprole 18.5 SC - Flubendiamide 480 SC - Dimethoate 30 EC	1.9	0.5 (1.2)	0.2 (1.1)	0.7 (1.3)	0.5 (1.2)	88.6	7.8	1.0 (1.4)	1.1 (1.5)	1.1 (1.5)	1.1 (1.4)	88.7
M8	Untreated control	1.9	4.5 (2.4)	2.8 (2.0)	6.0 (2.6)	4.4 (2.3)	—	9.1	10.0 (3.3)	13.6 (3.8)	5.6 (2.6)	9.7 (3.3)	—
C.D at 5%		NS	0.11	0.14	0.08	0.11	—	NS	0.15	0.17	0.13	0.15	—
C.V (%)		6.2	9.6	11.2	8.0	9.6	—	11.5	9.0	9.0	8.9	9.0	—

* Figures in parenthesis indicate SQRT transformed values; DBS- Day before spraying; NS: Non significant

RESULTS AND DISCUSSION

The results showed that all the insecticidal modules were able to reduce the larval population and pod damage due to different pod borers on pigeonpea over control.

Larval population and pod damage due to *H. armigera*: The three year consolidated results revealed that larval population of *H. armigera* was lowest (0.4 larvae/plant) in M4 which was on par with M7 (0.5), M1 (0.7) and M6 (0.8). Overall, M4 has recorded 90.9% reduction of larval population over control, followed by M7 (88.6%), M1 (84.0%) and M6 (81.8%). The least effective module was M2 (2.1 larvae/plant) as against 4.4 in untreated control (Table 1). With regard to per cent pod damage, module M7 (2.5), followed by M6 (3.1), M4 (4.4) and M5 (5.3) respectively with 80.2, 75.4, 65.1 and 57.9 per cent reduction of pod damage over control (12.6) were proved better than rest of the modules (Table 2). The effectiveness of emmamectin benzoate and chlorantraniliprole 20 SC against *H. armigera* was reported by Sharma *et al.,* (2011) and Chowdary *et al.,* (2010), respectively. Similarly, flubendiamide 20 WDG @ 50 g a.i. ha^{-1} (Dodia *et al*., 2009 ; Meena *et al*., 2006) and spinosad 45 SC (73 g a.i. ha^{-1}) (Mittal and Ujagir, 2005; Srinivasan and Durairaj, 2007; Sai *et al*., 2018 ; Divyasree *et al*., 2020) were found effective against *H. armigera*.

Larval population and pod damage due to *M. vitrata*: The overall efficacy data against *M. vitrata* revealed that most effective module was M7 (1.1 larvae/plant), followed by M4 (1.5). The next best modules were M1 (2.2), M6 (2.5) and M5 (2.6). The least effective modules were M3 (3.4) and M2 (5.1) as against 9.7 larvae per plant in untreated control. Overall, modules M7 and M4 with 88.7 and 84.5% reduction of *M. vitrata* population over control were proved best (Table 1). The cumulative pod damage due to *M. vitrata* was lowest in module M7 (4.9%), followed by M6 (6.9%) and M4 (7.8%). The next best treatment was M5 which has recorded 8.9% pod damage. The rest of the modules *viz*., M1, M3 and M2, respectively with 12.3, 12.8 and 14.7% pod damage due *M. vitrata* were least effective as against 18.8% in untreated control. Thus, the modules M7, M6, M4 and M5 respectively recorded 74.0, 63.3, 58.5 and 52.7% reduction of pod damage over control (Table 2). The effectiveness of flubendiamide 24% + thiacloprid 48% SC, spinosad, chlorantraniliprole, spinosad and indoxacarb, novaluron and spinosad in different concentrations against *M. vitrata* was reported by Divyasree *et al*., (2020); Sai *et al*., (2018); Mahalakshmi *et al*., (2016); Sreekanth *et al*., (2015a); Sreekanth *et al*., (2014); Sunita Devi *et al*., (2014); Sreekanth *et al.,* (2013); Shivaraju *et al.,* (2011); Dodia *et al*., (2009); Haritha (2008); Rao *et al.,* (2007); Chandrayudu *et al.,* (2006), respectively in different pulse crops.

Pod damage due to *M. obtusa*: The pod damage due to pod fly was low in module M7 (7.7%), followed by M6 (9.2%), M5 (10.8%) and M4 (11.6%) which have registered 76.3, 71.7, 66.8 and 64.3% reduction of pod damage over control (32.5%). The least effective modules were M1 (19.7%), M2 (19.0%) and M3 (15.1%) (Table 2). Spinosad was found to cause low pod damage due to *M. obtusa* was reported by Halder *et al.* (2006); Meena *et al.* (2006); Singh and Yadav (2006); Babariya *et al.,* (2010), whereas, Giraddi *et al.* (2002) reported that indoxacarb was highly effective. Meena *et al.,* (2006) reported that emmamectin benzoate 5 WSG @ 11 g a.i/ha and flubendiamide 20 WG @ 50 g a.i/ha were found effective in recording low pod damage.

Table 2: Impact of different insecticidal modules against pod damage due to different pod borers in pigeonpea.

Module No.	Treatment details	Pod damage (%) due to														
		H. armigera					*M. vitrata*					*M. obtusa*				
		2015	2016	2017	Cumulative pod damage	Reduction over control (%)	2015	2016	2017	Cumulative pod damage	Reduction over control (%)	2015	2016	2017	Cumulative pod damage	Reduction over control (%)
M1	Acephate 75 SP – Acephate 75 SP – Chlorantraniliprole 18.5 SC	8.0 (16.4)	10.9 (19.3)	3.1 (10.1)	7.3 (15.7)	42.1	17.1 (24.4)	14.1 (22.1)	5.6 (13.7)	12.3 (20.5)	34.6	26.7 (31.1)	24.4 (29.6)	8.0 (16.4)	19.7 (26.4)	39.4
M2	Acetamiprid 20 SP – Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	10.3 (18.7)	13.7 (21.7)	4.0 (11.5)	9.3 (17.8)	26.2	18.4 (25.4)	18.0 (25.1)	7.6 (16.0)	14.7 (22.6)	21.8	24.2 (29.5)	20.6 (27.0)	12.1 (20.4)	19.0 (25.8)	41.5
M3	Dimethoate 30 EC – Dimethoate 30 EC – Chlorantraniliprole 18.5 SC	9.0 (17.5)	12.3 (20.5)	4.1 (11.7)	8.5 (17.0)	32.5	15.5 (23.2)	16.5 (24.0)	6.5 (14.8)	12.8 (21.0)	31.9	20.1 (26.6)	15.5 (23.2)	9.6 (18.1)	15.1 (22.9)	53.5
M4	Chlorantraniliprole 18.5 SC - Acephate 75 SP – Chlorantraniliprole 18.5 SC	4.0 (11.5)	7.2 (15.6)	2.0 (8.1)	4.4 (12.1)	65.1	9.3 (17.8)	10.5 (18.9)	3.6 (10.9)	7.8 (16.2)	58.5	18.3 (25.3)	11.6 (19.9)	5.0 (12.9)	11.6 (19.9)	64.3
M5	Chlorantraniliprole 18.5 SC- Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	3.8 (11.2)	9.5 (18.0)	2.5 (9.1)	5.3 (13.3)	57.9	9.9 (18.3)	12.3 (20.5)	4.5 (12.3)	8.9 (17.4)	52.7	16.8 (24.2)	9.1 (17.6)	6.6 (14.9)	10.8 (19.2)	66.8
M6	Chlorantraniliprole 18.5 SC- Indoxacarb 15.8 EC - Acetamiprid 20 SP	2.3 (8.7)	5.4 (13.4)	1.6 (7.3)	3.1 (10.1)	75.4	10.1 (18.5)	8.2 (16.6)	2.5 (9.1)	6.9 (15.2)	63.3	15.7 (23.3)	7.9 (16.3)	4.1 (11.7)	9.2 (17.7)	71.7
M7	Chlorantraniliprole 18.5 SC - Flubendiamide 480 SC - Dimethoate 30 EC	2.7 (9.5)	3.7 (11.1)	1.2 (6.3)	2.5 (9.1)	80.2	7.6 (16.0)	5.5 (13.6)	1.6 (7.3)	4.9 (12.8)	74.0	15.1 (22.9)	5.5 (13.6)	2.6 (9.3)	7.7 (16.1)	76.3
M8	Untreated control	12.3 (20.5)	19.4 (26.1)	6.2 (14.4)	12.6 (20.8)	—	20.7 (27.1)	25.8 (30.5)	10.0 (18.4)	18.8 (25.7)	—	42.0 (40.4)	40.2 (39.4)	15.2 (23.0)	32.5 (34.8)	—
C.D at 5%		3.8	1.9	4.1	3.3	—	4.7	2.2	5.3	4.1	—	7.5	2.1	4.4	4.7	—
C.V (%)		15.3	12.2	24.2	17.2	—	12.6	11.6	24.0	16.1	—	15.5	10.2	16.1	13.9	—

* Figures in parenthesis indicate arc sin percentage transformed values;

Overall, it was observed that pod damage due to pod borer complex comprising *H. armigera, M. vitrata* and *M. obtusa* was lowest in module M7 (15.2%), followed by M6 (19.3%), M4 (23.8%) and M5 (24.5%). The least effective modules were M2 (43.0%), M1 (39.3%) and M3 (36.4%). Thus, the module M7, M6, M4 and M5 respectively recorded 76.2, 69.8, 62.8 and 61.7% reduction of pod damage due to pod borer complex over control (63.9%) (Table 3).

Table 3: Impact of different insecticidal modules on pod damage due to pod borer complex in pigeonpea.

Module No.	Treatment details	Pod damage due to pod borer complex (%)#				
		2015	2016	2017	Cumulative pod damage	Reduction over control (%)
M1	Acephate 75 SP – Acephate 75 SP – Chlorantraniliprole 18.5 SC	51.8 (46.1)	49.5 (44.7)	16.6 (24.0)	39.3 (38.8)	38.5
M2	Acetamiprid 20 SP – Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	52.9 (46.8)	52.3 (46.3)	23.7 (29.1)	43.0 (41.0)	32.7
M3	Dimethoate 30 EC – Dimethoate 30 EC – Chlorantraniliprole 18.5 SC	44.6 (41.8)	44.3 (41.7)	20.2 (26.6)	36.4 (37.1)	43.0
M4	Chlorantraniliprole 18.5 SC - Acephate 75 SP – Chlorantraniliprole 18.5 SC	31.6 (34.1)	29.2 (32.7)	10.5 (18.9)	23.8 (29.2)	62.8
M5	Chlorantraniliprole 18.5 SC- Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	29.0 (32.6)	30.9 (33.8)	13.6 (21.6)	24.5 (29.7)	61.7
M6	Chlorantraniliprole 18.5 SC- Indoxacarb 15.8 EC - Acetamiprid 20 SP	28.1 (31.8)	21.5 (27.6)	8.2 (16.4)	19.3 (26.1)	69.8
M7	Chlorantraniliprole 18.5 SC - Flubendiamide 480 SC - Dimethoate 30 EC	25.5 (30.3)	14.7 (22.6)	5.3 (13.1)	15.2 (23.0)	76.2
M8	Untreated control	75.0 (60.5)	85.4 (67.5)	31.3 (34.1)	63.9 (53.1)	—
C.D at 5%		9.9	3.7	4.7	6.1	—
C.V (%)		13.9	10.6	11.7	12.1	—

* Figures in parenthesis indicate arc sin percentage transformed values;
\# Pod borer complex – Helicoverpa, Maruca and Pod fly

Spinosad @ 0.3 ml/l at 50% flowering, followed by flubendiamide @ 0.2 ml/l and chlorantraniliprole @ 0.3 ml/l at 10 days interval registered lowest pod damage due to pod borer complex with highest monetary returns was reported by Sreekanth *et al*., (2015b and 2018).

Sucking pests: The results showed that all the insecticidal modules were effective in reducing the sucking pests *viz.,* jassids and cow bugs over control. However, module M2 with 89.0 and 87.9% reduction of jassid and cow bug population respectively over control was proved better (Table 4).

Grain yield and economics: Highest grain yield of 1974 kg/ha was recorded in module M7, followed by M6 (1774), M4 (1642) and M5 (1542). Thus, the modules respectively recorded 150.5, 125.1, 108.4 and 95.7% increase in yield over control (788 kg/ha) and proved better than the rest of the modules. Highest monetary returns (Rs. 62856/-) with highest incremental cost benefit ratio (10.60) was obtained in module M7, followed by M6, M4, M1, M5, M3 and M2 (ICBR of 8.52, 6.35, 5.91, 5.66, 5.41 and 3.99, respectively) (Table 5).

Table 4: Impact of different insecticidal modules against sucking pests in pigeonpea.

Module No.	Treatments	Jassid population DBS (no./plant)	No. of Jassids/plant				Reduction over control (%)	Cow bug population DBS (no./plant)	No. of cow bugs / plant				Reduction over control (%)
			2015	2016	2017	Overall efficacy			2015	2016	2017	Overall efficacy	
M1	Acephate 75 SP – Acephate 75 SP – Chlorantraniliprole 18.5 SC	6.0	3.2 (2.0)	3.0 (2.0)	1.6 (1.6)	2.6 (1.9)	69.0	12.8	4.7 (2.4)	2.1 (1.8)	1.2 (1.5)	2.7 (1.9)	80.9
M2	Acetamiprid 20 SP – Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	6.4	2.0 (1.7)	0.6 (1.3)	0.1 (1.1)	0.9 (1.4)	89.0	13.3	3.3 (2.1)	1.2 (1.5)	0.5 (1.2)	1.7 (1.6)	87.9
M3	Dimethoate 30 EC – Dimethoate 30 EC – Chlorantraniliprole 18.5 SC	5.7	3.9 (2.2)	3.5 (2.1)	2.7 (1.9)	3.4 (2.1)	59.5	11.9	6.4 (2.7)	2.1 (1.8)	1.4 (1.6)	3.3 (2.1)	76.6
M4	Chlorantraniliprole 18.5 SC - Acephate 75 SP – Chlorantraniliprole 18.5 SC	5.9	4.9 (2.4)	4.2 (2.3)	3.3 (2.1)	4.1 (2.3)	51.1	11.4	7.0 (2.8)	2.1 (1.8)	1.2 (1.5)	3.4 (2.1)	75.9
M5	Chlorantraniliprole 18.5 SC- Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	6.2	5.7 (2.6)	3.8 (2.2)	2.5 (1.9)	3.0 (2.2)	64.3	11.9	8.0 (3.0)	2.5 (1.9)	2.1 (1.8)	4.2 (2.3)	70.2
M6	Chlorantraniliprole 18.5 SC- Indoxacarb 15.8 EC - Acetamiprid 20 SP	5.9	5.7 (2.6)	4.3 (2.3)	2.4 (1.9)	4.1 (2.3)	51.1	13.5	8.1 (3.0)	4.0 (2.2)	4.2 (2.3)	5.4 (2.5)	61.7
M7	Chlorantraniliprole 18.5 SC - Flubendiamide 480 SC - Dimethoate 30 EC	5.8	5.3 (2.5)	5.8 (2.6)	4.6 (2.4)	5.2 (2.5)	38.1	13.4	7.6 (2.9)	3.1 (2.0)	3.0 (2.0)	4.6 (2.4)	67.4
M8	Untreated control	6.3	7.8 (3.0)	9.3 (3.2)	8.1 (3.0)	8.4 (3.1)	—	13.2	15.2 (4.0)	14.2 (3.9)	12.8 (3.7)	14.1 (3.9)	—
C.D at 5%		NS	0.40	0.14	0.09	0.21	—	NS	1.01	0.41	0.11	0.51	—
C.V (%)		6.6	8.9	10.8	2.5	7.4	—	8.9	9.5	11.2	8.3	9.7	—

* Figures in parenthesis indicate SQRT transformed values; DBS- Day before spraying; NS: Non significant

Table 5: Economics of different insecticidal modules against pod borer complex in pigeonpea.

Module No.	Treatments	Yield (kg/ha)				Increase n yield over control (kg/ha)	Increase in yield over control (%)	Cost of increased yield / ha (Rs.) [A]	Plant protection cost /ha* (Rs.) [B]	Net profit/ha (Rs.) [A-B]	ICBR [A-B] / [B]
		2015	2016	2017	Average						
M1	Acephate 75 SP – Acephate 75 SP – Chlorantraniliprole 18.5 SC	758	1443	1867	1356	568	72.1	32944	4768	28176	5.91
M2	Acetamiprid 20 SP – Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	695	1165	1644	1168	380	48.2	22040	4417	17623	3.99
M3	Dimethoate 30 EC – Dimethoate 30 EC – Chlorantraniliprole 18.5 SC	720	1327	1822	1290	502	63.7	29116	4540	24576	5.41
M4	Chlorantraniliprole 18.5 SC - Acephate 75 SP – Chlorantraniliprole 18.5 SC	1319	1590	2017	1642	854	108.4	49532	6741	42791	6.35
M5	Chlorantraniliprole 18.5 SC- Acetamiprid 20 SP – Chlorantraniliprole 18.5 SC	1197	1512	1917	1542	754	95.7	43732	6565	37167	5.66
M6	Chlorantraniliprole 18.5 SC- Indoxacarb 15.8 EC - Acetamiprid 20 SP	1713	1667	1944	1774	986	125.1	57188	6009	51179	8.52
M7	Chlorantraniliprole 18.5 SC - Flubendiamide 480 SC - Dimethoate 30 EC	1828	1836	2256	1974	1186	150.5	68788	5932	62856	10.60
M8	Untreated control	618	617	1128	788	—	—	—	—	—	—
C.D at 5%		80.9	181.2	212.7	158.3	—	—	—	—	—	—
C.V (%)		4.2	7.4	6.7	6.1	—	—	—	—	—	—

ICBR: Incremental Cost Benefit Ratio;

CONCLUSIONS

The present findings conclude that application of chlorantraniliprole 18.5 SC @ 0.3 ml/l, followed by flubendiamide 480 SC @ 0.2 ml/l and dimethoate 30 EC @ 2.0 ml/l at 15 days interval starting from 50% flowering stage of the crop will contain the pod borer complex on pigeonpea with more yield and high monetary returns. Further, it was suggested that the future scope in the research will be on the evaluation of new combination molecules or bio-pesticides to safe guard the environment and also to delay the development of resistance.

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